

## AUSTRALIAN RUST STUDIES. IV.

### NATURAL INFECTION OF BARBERRIES BY BLACK STEM RUST IN AUSTRALIA.

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(Plate iii.)

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#### *Introduction.*

For long it was believed that black stem rust in Australia was unable to attack the barberry. McAlpine (1906) in his experiments failed to obtain any infection. In 1921 (Waterhouse, 1921) it was shown that rust on wheat from Glen Innes produced normal infections of the barberry under experimental conditions at the University of Sydney. Similar results (Waterhouse, 1929) have been repeatedly obtained in subsequent years. But, although search has been made, no natural infection of the barberry has yet been recorded. It is perhaps on this account that barberry eradication has so far not received attention in Australia.

#### *Field Occurrence.*

In early December, 1933, Messrs. S. L. Allman and R. E. Dwyer, officers of the New South Wales Department of Agriculture stationed at the Bathurst Experiment Farm, noticed a leaf infection of barberry and forwarded three young shoots for examination. These were found to be carrying a number of spermogonia and a few aecidia. Messrs. Allman and Dwyer had collected the material from plants growing in the shrubbery of Mr. C. Bland at Yetholme, N.S.W.

Examination of the few acidiospores present showed that they conformed to the *Puccinia graminis* type. They were used to inoculate seedlings of wheat, oats, barley and rye in the plant house. The result, to be discussed later, was the production of a single uredo pustule on the wheat seedlings.

Upon receipt of the material, a brief visit was at once paid to the locality in company with Mr. Allman. Mr. and Mrs. Bland showed the utmost hospitality and gave every assistance in the examination. Growing in the shrubbery near the homestead were three well-established barberry bushes producing fruit which at that time was about half-grown (Plate iii, C). On the leaves of all the bushes many infections were found. Spermogonia and aecidia were clearly discernible on some leaves, but in most cases the infected areas had completely blackened owing to age, indicating that the visit was made about a month later than it should have been. On many twigs each successive shoot was infected. One of these is illustrated in Plate iii, C.

A number of grasses were found growing under and around the barberry bushes. They comprised *Agropyron scabrum*, *Bromus maximus*, *B. racemosus*, *Festuca Myuros*, *Lolium perenne*, and *Danthonia* sp., together with others not in head. Inflorescences of the first four listed were growing right up into the

barberries, some heads of the first-named being almost as tall as the barberries themselves. One of these emerging from the barberry is shown in Plate iii, B.

Rust in the uredospore stage was present on the grasses above named. The bromes and rye grasses showed leaf rust attack only, but *Agropyron scabrum* was attacked on both leaves and stems by stem rust. This proved to be a typical *P. graminis*.

In addition to the uredosori, abundant teleutosori were present. These occurred on old grass stems, definitely traced back in every case to the growing plants of *Agropyron scabrum*. Germination tests with the spores made upon return to the laboratory gave negative results. This was quite in accord with the expectancy (Waterhouse, 1929).

Thus, apart from the sporidia, there were associated in the closest proximity to each other, all the spore forms of stem rust.

At the time of the visit, a crop of oats was growing in a paddock distant about 200 yards from the infected barberries in the shrubbery. Enquiry elicited the information from Mr. Bland that attempts to grow wheat had resulted in failure owing to rust attack.

It was pointed out by Mr. Bland that other barberry bushes were growing in the neighbourhood. Owing to limited time, however, only one of these areas, skirting the "Old Sydney Road" in Yetholme, was visited. Here eight barberry bushes were found. The largest of them measured 8 ft. in height and 12 ft. across its largest diameter (Plate iii, A). Every one of these bushes showed rust-infected shoots. Nearly all the pustules had blackened with age. The grasses in this area were similar to those noted in Mr. Bland's property. It was stated that yet other patches of barberries occurred in the vicinity, and that some of them had been there for 60 years.

#### *Plant House Determinations.*

Upon return from the field, inoculations of cereal seedlings (wheat, oats, barley and rye) were made in the plant house. These dealt with three collections of rust, viz., aecidiospores from the barberries, uredospores from *Agropyron scabrum* growing intermixed with the barberries, and, thirdly, the same material collected in the open at a distance of about 200 yards from the barberries.

From the scanty aecidial material, only one pustule appeared on wheat. This inoculum was multiplied and then used to inoculate the standard set of differential hosts (Stakman and Levine, 1922). The rust proved to be *Puccinia graminis tritici*, form 34. This is not at variance with a considerable amount of work, yet unpublished, which proves clearly that form 34 is heterozygous. Had an extensive collection of aecidia been possible, others of the forms which have recently been separated out from barberry inoculations with form 34 would probably have been found.

Tests with the rust on *Agropyron scabrum* growing intermixed with the barberry proved this rust to be the same as the preceding, viz., *P. graminis tritici* 34. The same result was obtained with the rust on *A. scabrum* growing at a distance in the open paddock. This again was necessarily a scanty collection owing to time limitations.

It has previously been shown (Waterhouse, 1929) that stem rust occurs on *A. scabrum* growing in different localities. With one exception, when *P. graminis avenae* was present, the rust has proved to be the one or other of known forms of *P. graminis tritici*. In recent years it has always been form 34.

*Conclusion.*

The occurrence of natural infection of the barberry is vitally important in view of the proof that new physiologic forms of stem rust originate on the barberry (Waterhouse, 1929, et al.). Change in the rust flora may thus take place readily where infected barberries are present. The singularly fortunate circumstance, from a wheat breeder's point of view, that only the one form of wheat stem rust is now present in wheat, may be completely altered in this manner and the problem of breeding for rust-resistance made much more difficult. Especially does this danger exist with a heterozygous rust like form 34.

The climatic conditions at Yetholme, situated at an altitude of 4,000 ft., approximate to English conditions, and are not extensively replicated in New South Wales. Nevertheless, wheat-growing is carried on less than five miles in a direct line from the infected barberries. These wheat areas in turn link up with others and by means of these crops—not taking grasses into consideration—spread of uredospores throughout the wheat belt can readily take place under favourable conditions for rust development.

In view of the fact that under some conditions barberries may become naturally infected by stem rust, steps should be taken to eradicate the susceptible sorts and to prevent their dissemination. If it is desired to grow barberries, only immune sorts should be tolerated.

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*Summary.*

In December, 1933, Messrs. Allman and Dwyer found infected barberries growing under natural conditions at Yetholme, N.S.W. The rust proved to be *P. graminis tritici* 34. The same form was present on *Agropyron scabrum* growing intermixed with the barberries. Old stems of this grass were heavily infected with the teleutosori which were doubtless the source of the barberry infection. The same grass growing a considerable distance away from the barberries was attacked by the same rust. Rust-susceptible barberries should be eradicated.

*Literature Cited.*

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## EXPLANATION OF PLATE III.

A. One of the old barberry bushes growing at the roadside in Yetholme. The fence post is 4 feet 6 inches high.

B. A barberry bush in Mr. Bland's shrubbery. At a spot 1 inch from the left of the photograph, and  $1\frac{1}{4}$  inches above the bottom—i.e., almost above the "two-foot" rule—an inflorescence of *Agropyron scabrum* may be seen protruding from the barberry.

C. A twig of barberry showing infected leaves of successive shoots.  $\times \frac{3}{4}$ .